

AMENDMENTS TO THE CLAIMS

This listing will replace all prior versions, and listings, of claims, in the application:

Listing of Claims:

1. (currently amended) A diaphragm valve having a plurality of external ports and comprising:

a valve body (1) having an inlet sleeve (3) and an outlet sleeve (4) each connected to an external entry port, the inlet sleeve (3) and outlet sleeve (4) having ~~an arched profile~~ converging arched profiles in the longitudinal direction, and a circular cross-section at the external entry port;

a fluid flow chamber where the inlet sleeve (3) and outlet sleeve (4) converge, the fluid chamber having one part integral with the valve body (1) and peripherally delimited by a body clamping flange (101) that contains a flow chamber port, and another part comprising a bonnet (2) to be sealably secured onto said valve body (1), the bonnet having a coincident peripheral bonnet clamping flange (102) coincident with the body clamping flange (101);

a valve seat (106) contained in the flow chamber, the valve seat having an arched profile of substantially elliptical curvature and a flattened central surface, the valve seat (106) being shaped by the intersection of the arched profiles of the inlet sleeve (3) and outlet sleeve (4) on the side of the valve body (1) opposite to the bonnet;

an open/close element comprising a diaphragm (5) made of an elastomeric material, the diaphragm comprising a peripheral sealing flange (105) to be clamped between the body clamping flange (101) and the bonnet clamping flange (102), said sealing flange (105) being connected to a central dome (305), the dome having a convex side and a concave side, the concave side being oriented, in an unstressed position, toward the valve seat (106); and

means for compressing the diaphragm against the valve seat (106) to prevent any fluid flow from the inlet sleeve (3) to the outlet sleeve (4) while allowing free fluid flow when the dome (305) is lifted and deformed toward the bonnet (2),

wherein the cross sections of the inlet sleeve (3) and the outlet sleeve (4) each have an elongated semi-elliptical shape at the respective openings into the fluid flow chamber, the cross sections of the inlet sleeve (3) and the outlet sleeve (4) being elongated in a direction transverse to the direction of flow, the semi-elliptical shape being defined by an arched portion on the outer side and a flattened portion on the inner side, the semi-elliptical shapes converging at the valve seat to provide the substantially elliptical curvature,

wherein the sealing flange (105) of the diaphragm (5) has an elongated shape inscribing the dome (305) of the diaphragm (5),

wherein the sealing flange is joined to the dome along a substantially elliptical edge having a longer central axis and a shorter central axis, and

wherein the dome (305) is substantially shaped like a sector of an ellipsoid so to cooperate with the flow chamber port.

2. (previously presented) The valve as claimed in claim 1, wherein the inlet sleeve (3) and outlet sleeve (4) each have a cross section progressively widening in the direction substantially perpendicular to the flow direction and to the radius of curvature of the arched profile and progressively narrowing in the longitudinal direction of the inlet and outlet sleeves,

wherein the flow chamber port has a shape that is elongated in the direction perpendicular to the longitudinal axis of the diaphragm valve, the sealing flange having a shape matching the shape of the bonnet clamping flange and inscribing the dome (305) of the diaphragm (5), .

3. (previously presented) The valve as claimed in claim 1, characterized in that the dome (305) of the diaphragm (5) has one or more stiffening ribs to enhance the mechanical properties of the dome (305) and to prevent the dome (305) from bulging when the dome (305) is compressed against the valve seat (106).

4. (previously presented) The valve as claimed in claim 3, wherein at least one rib (405) is provided on the side of the dome (305) facing the bonnet (2) and is oriented substantially parallel with the longer axis of the dome (305).

5. (previously presented) The valve as claimed in claim 3, wherein a plurality of ribs (505) is provided on the side of the dome (305) facing toward bonnet (2) and is oriented substantially parallel to the shorter axis of the dome (305).

6. (previously presented) The valve as claimed in claim 3, further comprising one or more pairs of ribs (on the side of the dome (305) facing the bonnet (2), the one or more pairs of ribs being disposed to divide the dome into two or more webs, while connecting the longer central axis of the dome (305) with the sealing flange.

7. (previously presented) The valve as claimed in claim 3, further comprising a central stiffening member (605) on the side of the dome (305) facing the bonnet (2).

8. (previously presented) The valve as claimed in claim 7, wherein the one or more stiffening ribs and the central stiffening member (605) are locally thickened wall portions of the dome (305).

9. (previously presented) The valve as claimed in claim 3, wherein the dome (305) has a constant thickness, and which at least some of the one or more stiffening ribs have a thickness progressively increasing toward the center of the dome (305).

10. (previously presented) The valve as claimed in claim 1, further comprising means for retaining the periphery of the sealing flange (105) in position, thereby preventing the sealing flange (105) from sliding along the junction of the bonnet clamping flange and the body clamping flange.

11. (previously presented) The valve as claimed in claim 10, wherein said retaining means comprise one or more retaining teeth extending in a substantially perpendicular direction from the sealing flange (105) at the outer edges of the bonnet clamping flange and the body clamping flange.

12. (previously presented) The valve as claimed in claim 10, wherein the retaining means consist of two retaining tabs (705), each being provided along one of the longer sides of the sealing flange (105) and extending over the corresponding surface of the outer edge of the body clamping flange (101) with an orientation substantially perpendicular to the plane of said body clamping flange (101).

13. (previously presented) The valve as claimed in claim 10, wherein the retaining means comprise one or more bosses (402) provided on the clamping surface of the body clamping flange and bonnet clamping flange, the one or more bosses compressing the corresponding portion of the sealing flange (105) and further preventing the sealing flange (105) from sliding out of position.

14. (previously presented) The valve as claimed in claim 10, wherein said retaining means consist of a substantially elliptic projection (402) provided on the bonnet clamping flange, the substantially elliptic projection being positioned to be substantially parallel to the dome (305) and to press against the sealing flange (105).

15. (previously presented) The valve as claimed in claim 1, further comprising means (502) for centering the bonnet (2) with respect to the valve body (1) and for laterally limiting any outward extension of the sealing flange (105).

16. (previously presented) The valve as claimed in claim 15, wherein said means for centering comprise one or more retaining teeth arranged along the outer peripheral edge of the bonnet clamping flange (102) and extending over the surface of the outer edge of the body clamping flange (101) with a substantially perpendicular orientation to the plane of the body clamping flange (101).

17. (previously presented) The valve as claimed in claim 16, wherein said means for centering comprise a tab (502) continuously extending along the entire peripheral edge of the bonnet clamping flange (102) and extending over the corresponding surface of the outer edge of the body clamping flange (101) with a substantially perpendicular orientation with respect to the plane of said body clamping flange (101).

18. (previously presented) The valve as claimed in claim 1, wherein the sealing flange (105) has at least one lip seal extending parallel to the peripheral edge of the dome (305) and at a distance therefrom.

19. (previously presented) The valve as claimed in claim 1, further comprising a central, rounded lip seal (905) on the side of the dome (305) facing the valve seat (106), the lip seal extending along the longer axis of the dome (305) and acting as a compliant element favoring the adhesion of the dome (305) against the valve seat (106), so to prevent any fluid flow from the inlet sleeve (3) to the outlet sleeve (4).

20. (previously presented) The valve as claimed in claim 1, further comprising a rib in an intermediate position at the opening of the outlet sleeve (4) into the flow chamber, the rib being oriented in the flow direction and being substantially perpendicular to the plane tangent to the lower apex of the surface of the valve seat (106), the rib having a surface at the edge facing the dome (305) that is flattened and curved to cooperate with the dome, so to prevent the dome (305) from bulging when compressed against the valve seat (106).

21. (previously presented) The valve as claimed in claim 1, wherein the valve is actuated, wherein the valve is a manually actuated valve, a mechanically actuated valve, a hydraulically actuated valve, or a servo actuated valve.

22. (previously presented) The valve as claimed in claim 21, wherein the valve is a mechanically actuated valve, further comprising a compressor element (8) on the side of the dome (305) facing the bonnet, the compressor element having a pressing surface of a shape complementary to the dome (305), the compressor being rotatably linked to the inner end of a slidable control stem which is passed through a hole formed in the bonnet (2).

23. (previously presented) The valve as claimed in claim 21, wherein the valve is a hydraulically operated valve, further comprising means for supplying a pressurized fluid between the bonnet (2) and the dome (305) for the purpose of compressing the dome (305) against the valve seat (106) and close the valve, further comprising means for discharging said pressurized fluid and open the valve.

24. (previously presented) The valve as claimed in claim 1, further comprising means (7) for elastically preloading the dome (305) of the diaphragm (5) towards the valve seat (106).

25. (previously presented) The valve as claimed in claim 24, wherein said means for elastically preloading comprise a spring (7) interposed between the opposing surfaces of the bonnet (2) and the dome (305), while a rigid pressure element (8) of a shape corresponding to the concave side of the dome (305) is interposed between said spring (7) and said dome (305).

26. (previously presented) The valve as claimed in claim 1, wherein the valve body (1) is made of plastic, the fluid flow chamber further comprising two pocket-like chambers closed at their external sides and open at their internal sides, the pocket-like chambers (13, 14) being disposed in adjacent positions, the internal sides of the pocket-like chambers being connected to a common opening (206) of the fluid flow chamber the common opening having an elongated shape in the flow direction, and being surrounded by the body clamping flange (101) of a cooperating elongated shape, the two pocket-like chambers (13, 14) having each two opposed walls (113, 114) and having upper edges of concave shape that face the opening (206) and that slope in the direction of the central area of the fluid flow chamber from the two opposing points substantially level with the edge of the opening (206), said upper edges of the two opposed walls (113, 114) being connected to each other by a surface forming the valve seat (106).

27. (previously presented) The valve as claimed in claim 26, wherein the walls of the pocket-like chambers are substantially perpendicular to the flow direction, and wherein the inlet sleeve (3) and outlet sleeve (4) have longitudinal axes substantially perpendicular to the walls of the pocket-like chambers.

28. (previously presented) A valve as claimed in claim 26, wherein the two opposed walls of the two pocket-like chambers are divergent and connected together by a plurality of stiffening ribs that are oriented perpendicular to the body clamping flange (101) and parallel to the flow direction.

29. (previously presented) A valve as claimed in claim 28, wherein at least some of the plurality of stiffening ribs for connecting the opposed walls of the two pocket-like chambers

extend for the entire length of the two opposed walls from the in a direction perpendicular to the body clamping flange (101).

30. (previously presented) A valve as claimed in claim 28, wherein at least some of the stiffening ribs connecting the two pocket-like chambers extend for the entire length of the two opposed walls of said pocket-like chambers) to reach the outer surface of the valve body, thereby forming supporting feet.

31. (previously presented) The valve as claimed in claim 1, wherein the bonnet (2) is made of a resilient material, wherein the resilient materials is plastic or sheet metal.

32. (previously presented) The valve as claimed in claim 1, wherein the sealing flange (105) is clamped between the body clamping flange (101) and the bonnet clamping flange (102) by four or more fastening bolts in the proximity of the corners of the shorter sides of said body clamping and bonnet clamping flanges.

33. (previously presented) The valve as claimed in claimed 32, wherein the body clamping flange (101) and the bonnet clamping flange (102) have rectangular shapes.

34. (previously presented) A diaphragm open/close element for a diaphragm valve comprising:

a dome (305) having a concave side and a convex side, the dome being shaped like a portion of an ellipsoid and having a longer central axis and a shorter central axis; and

a peripheral sealing flange (105) having a substantially rectangular shape, the sealing flange being joined to the dome and surrounding the dome.

35. (previously presented) The diaphragm open/close element as claimed in claim 34, wherein the dome (305) has one or more stiffening ribs increasing the mechanical properties of the dome and preventing the dome (305) from bulging when the dome is stressed to close the diaphragm valve.

36. (previously presented) The diaphragm open/close element as claimed in claim 35, wherein at least one stiffening rib (405) is situated on the concave side of the dome (305) and is oriented along one of the central axes of said dome (305).

37. (previously presented) The diaphragm open/close element as claimed in claim 36, wherein a plurality of ribs is oriented parallel to the shorter central axis of the dome.

38. (previously presented) The diaphragm open/close element as claimed in claim 35, wherein the dome has one ribs along its longer central axis, further comprising one or more additional pairs of ribs (505) on the concave side of the dome (305), the one or more additional pairs of ribs being disposed as to connect the longer central axis with the periphery of the dome (305).

39. (previously presented) the diaphragm open/close element as claim 38, further comprising a central stiffening member (605) on the concave side of the dome (305).

40. (previously presented) The diaphragm open/close element as claimed in claim 39, wherein all ribs and the central stiffening member (605) are locally thickened wall portions of the dome (305), wherein the dome (305) has a constant thickness, and wherein at least some of the ribs have a thickness that progressively increases in the direction of the center of the dome (305).

41. (currently amended) A diaphragm valve having a plurality of external ports and comprising:

a valve body (1) having an inlet sleeve (3) and an outlet sleeve (4) each connected to an external ports, the inlet sleeve (3) and outlet sleeve (4) having an arched profile converging
arched profiles in the longitudinal direction and a circular cross-section at the external port;

a fluid flow chamber where the inlet sleeve (3) and outlet sleeve (4) converge, the fluid chamber having one part integral with the valve body (1), and peripherally delimited by a body clamping flange (101) that contains a flow chamber port, and another part comprising a bonnet (2) to be sealably secured onto said valve body (1), the bonnet having a coincident peripheral bonnet clamping flange (102) coincident with the body clamping flange (101);

a valve seat (106) contained in the flow chamber, the valve seat having an arched profile of substantially elliptical curvature and a flattened central surface, the valve seat (106) being shaped by the intersection of the arched profiles of the inlet sleeve (3) and outlet sleeve (4) on the side of the valve body (1) opposite to the bonnet;

an open/close element comprising a diaphragm (5) made of an elastomeric material, the diaphragm comprising a peripheral sealing flange (105) to be clamped between the body clamping flange (101) and the bonnet clamping flange (102), said sealing flange (105) being connected to a central dome (305), the dome having a convex side and a concave side, the concave side being oriented, in an unstressed position, toward the valve seat (106); and

means for compressing the diaphragm against the valve seat (106), so to prevent any fluid flow from the inlet sleeve (3) to the outlet sleeve (4) while allowing free fluid flow when the dome (305) is lifted and deformed toward the bonnet (2),

wherein the cross sections of the inlet sleeve (3) and the outlet sleeve (4) each have an elongated semi-elliptical shape at the respective openings into the fluid flow chamber, the cross sections of the inlet sleeve (3) and the outlet sleeve (4) being elongated in a direction transverse to the direction of flow, the semi-elliptical shape being defined by an arched portion on the outer side and a flattened portion on the inner side, the semi-elliptical shapes converging at the valve seat to provide the substantially elliptical curvature,

wherein the sealing flange (105) of the diaphragm (5) has an elongated shape inscribing the dome (305) of the diaphragm (5),

wherein the sealing flange is joined to the dome along a substantially elliptical edge having a longer central axis and a shorter central axis,

wherein the dome (305) is substantially shaped like a sector of an ellipsoid so to cooperate with the flow chamber port, and

wherein a measuring device is integrated with the inlet sleeve of the valve body.